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Rent sharing in the Clean Development Mechanism

The Case of the Tahamanu Hydroelectric Project in Bolivia

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Abstract :

The Clean Development Mechanism (CDM) of the Kyoto Protocol, aims to minimise the cost of Annex B countries' commitments to reduce emissions, but also to limit the risk that the Developing Countries unquestionable right to develop will offset the Annex B countries efforts: the CDM should promote faster progress along a less polluting development path. Beyond political principles, the pertinent players have to be incorporated into the decision making process of future CDM. The issues for host country include attracting the investment capacity, by taking advantage of the additional incentive created by CDM certificates. For private investors, the objective is to maximise the sum of commercial revenues *plus* CDM carbon income.

This paper examines potential CDM project opportunities in the power sector. The Tahumanu project consists of building a hydroelectric power plant instead of subsidized diesel plants in the Bolivian Pando Province. Simulations show that it offers a realistic illustration of possible set up and arrangements of CDM projects with the host country.

Keywords :

Bolivia, power sector, GHG emission reductions, private sector, decision process, carbon rent.

1. Introduction :

In 1997 in Kyoto, at the fourth “Conference of the Parties” (2), the industrialised countries, also known as the Annex B countries, made quantified commitments to reduce their national greenhouse gas emissions within the framework of the Kyoto Protocol. To honour their commitments, the signatory countries will set up national mechanisms for restrictions and incentives acting on the emitting agents.

To minimise and distribute the reduction costs for all Annex B countries, the Kyoto Protocol adopted flexible mechanisms ; these mechanisms include establishing the market for tradable emission permits (trading), the Joint Implementation (JI) and the Clean Development Mechanism (CDM). Annex B countries and their emitting agents will be able to use these mechanisms to achieve or acquire emission reductions in other countries more cheaply than would be possible in their own.

Developing Countries themselves have refused to commit themselves to reducing their own emissions, because they considered that such commitments would generate additional constraints on their future development, and because the historical responsibility for climate risk falls on industrialized countries.

Experts, however, anticipate that within a few decades, the emissions of DCs, taken as a whole, will reach a level which is equivalent to that of Annex B countries. Controlling the emissions of DCs is therefore a major challenge if the objectives of the Climate Convention are to be met.

For industrialized countries, so-called Annex B countries, the main interest of the Clean Development Mechanism is to provide a large potential for emission reductions at a lower cost. Consequently, whereas the « flexibility » dimension is explicit, the « developmental » dimension remains unclear. The definition of the mechanism itself includes the statement that *"the purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development"*, but one of the most obvious risks is to divert the use of this instrument towards projects which would only lead to emission reductions and to few or no benefits in terms of development. The CDM could then be accused of creating new economic enclaves, like the ancient mining exploitations, which generate few positive externalities in development.

At the Kyoto Conference the Developing Countries opposed the principle of pure flexible mechanisms offering no guaranteed contribution to their development needs. As a consequence, the Clean Development Mechanism emerged as a late compromise in response to these concerns.

The CDM should contribute to reducing the costs of the commitments made by industrialized countries, and also avoid the legitimate growth of Developing Countries cancelling out those efforts. Its effectiveness therefore depends on the capacity of the economic and political players to adopt an approach that continuously associates the development needs of the DCs and the control of greenhouse gas emissions.

1.1. Faster progress along a less-polluting development path

Motivated by the certificates of emission reductions (CERs) that they can obtain from CDM projects to meet their own Annex B commitments, or by the income that they anticipate from these CERs, foreign investment will focus more on the non-Annex B countries. At the same time official assistance has fallen significantly since the beginning of the 1980s¹.

Seen from these countries, the main assistance for projects that the CDM will generate will thus be to attract more private-sector investment for funding.

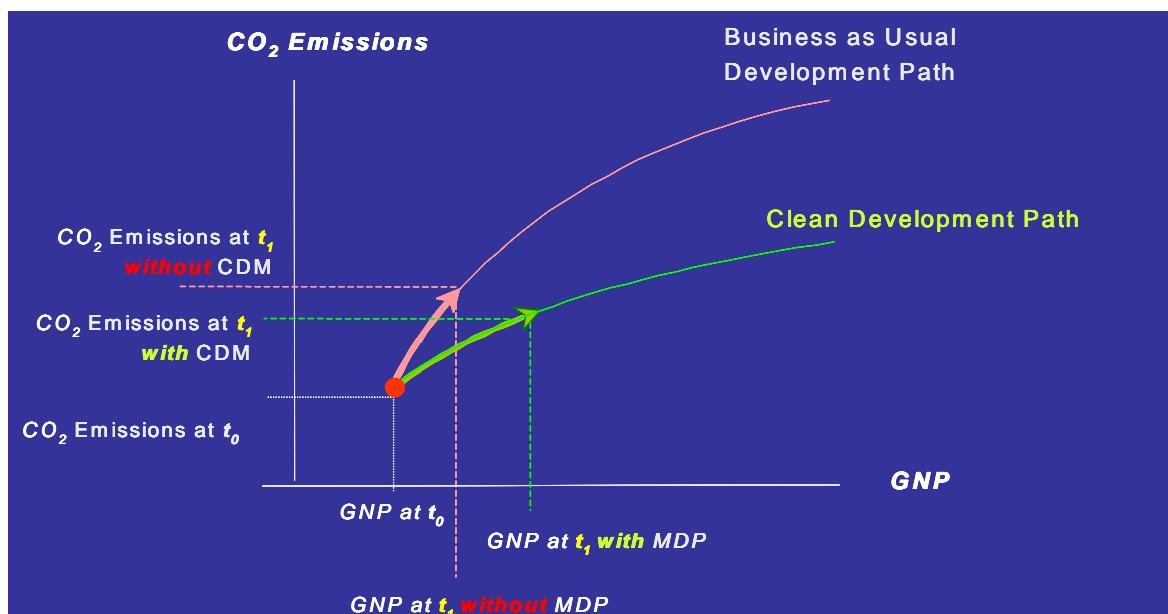
¹ Despite an apparent near-stationary level in absolute value, at above 50 billion dollars per year, Official Development Aid (ODA) fell considerably during the 1990s in terms of the effort made by the donor countries, decreasing from 0.33% to 0.22% of GDP, equivalent to a shortfall of 21 billion dollars in 1998 (OECD, 2000).

The stakes in terms of sustainable development are two-fold:

- to stimulate the transfer of technologies to DCs, resulting in access to more effective and less polluting technologies, and ultimately to a switch to a development path less intensive in greenhouse gas (GHG) emissions. In addition to contributing to the mitigation of climate change, most of the clean technologies promoted by the CDM will also contribute to reducing local pollution;
- to remove funding restrictions, insofar as access to capital is easier and the cost of capital is lower for the investors from Annex B countries, and thus facilitate faster progress along a “cleaner” development path than would have been possible in the absence of the CDM (Mathy, Hourcade and de Gouvello 2001).

The CDM will lead to a win-win result if the non-Annex B countries make faster progress towards their development objectives, while emitting less CO₂ than if they had progressed alone on the present development path. This is illustrated in graph n°1.

Graph n° 1



1.2. Environmental Rent, Commercial Rent and Social Rent associated with CDM projects

To clarify the incentive effect which CDM may have on private economic players in Annex B countries, it is important to assess their view of it realistically.

A limited appreciation consisting of considering that the only motivation of a « CDM » investor would be restricted to generating low cost emissions reductions is inappropriate. This motivation is, nevertheless, real and natural. For example, it applies to a project of modernization of a cement factory leading to reducing the previously observed greenhouse gas emissions, and this at a unit cost below the margin abatement cost in the country of the investor, or on the TEP market². Such an investor acts according to a cost-efficiency logic. He decides to invest if his analysis shows that the unit cost of the reductions will be lower than

² Although this theoretical situation seems quite simple, emission reductions will most probably not be the unique motivation for modernising a cement factory.

the costs he would have to face in his own country to attain the quantitative reduction goals for which he is responsible. Alternatively, he will try to generate reductions whose unit cost is below the usual prices on the TEP market so as to profit from the difference.

The range of projects eligible for CDM is in fact much wider because it is open to all foreign investment opportunities in every sector, whenever there is a technical alternative enabling avoidance of greenhouse gas emissions.

Therefore, an appropriate perspective is required to anticipate the variety of possible projects. For most industrial investment projects, the decision is mainly guided by analysis of the *cost-benefit* type: an investment project is only implemented if the *cost-benefit* analysis is conclusive for the investor whose main revenues will come from the marketing of products and services resulting from the main targeted activity, i.e. from the **commercial rent**. The value of emission reduction certificates expected on the emission permit market is in this case added to the conventional commercial income, and can therefore possibly make the difference when comparing the business plan for the « clean » project and that for a « dirty » project, taken as a reference project. The certificates issued in the framework of CDM consequently appear as an additional « **environmental** » **rent** in the analysis of the variants of investment projects.³

Many so-called development projects in DCs have mixed official-private financing structures. This type of financial set up is found in public commercial services, frequently leading to delegated management contracts: the financial structure may combine part of private investment provided by the concessionaire, which is limited by the expectation that revenues will be insufficient to remunerate the entire investment, and part of public funds. This is usually the case for urban transport (buses and metros), rubbish collection, rural electrification, certain road infrastructures and other similar types of project. Direct financing of a part of the investment costs by Public Authorities, without receiving commercial revenues is justified by the expected benefits for the community. When the activity is not profit-making and cannot be spontaneously developed by simple market forces, official or parapublic funding is necessary to attract private capitals.⁴

There are thus several facets to CDM projects: (i) mitigation of the greenhouse effect, (ii) incentives for private investors and (iii) development. These facets can be considered in the light of the three types of rents expected, the sharing of which requires a consensus between the investor and the Host Country :

- the classical commercial rent for a private investment from which it is necessary to deduct standard transaction costs associated with direct foreign investments, and which depending among other things on the characteristics of the host country.

³ Of course the creation of investors funds like the Prototype Carbon Fund implemented by the World Bank, is plausible. Such funds would only invest in the “additional project” or “dual” project as far as it can be identified. Such a “dual” project would consist in isolating the difference of cost between two projects (the “clean project” and the reference project) and rating it according to the certified emission reduction. Of course such “dual” investors would then only be interested in projects whose emission reduction unit cost, calculated in this way, would be below the market price of emission permits. For projects whose reduction unit cost is higher or incalculable, the main investor might not find any additional investor, but he could still valorise the CERs he could claim by selling at the market price. This would generate an additional rent.

⁴For the Least Developed Countries, only Official Development Aid (ODA) enables them to finance the non profit-making part of these activities, and this is of course independent of any consideration of climate change. It is therefore important not to confuse the legitimate refusal of any recycling of ODA to finance the buying of emission reduction in the DCs by Annex B countries, and the needs of ODA to make the non-profit-making part of developing projects viable, whether or not the projects are “clean”. This would seriously penalize the Least Developed Countries as compared to other Developing Countries, which do not need ODA to cover such non-profitable costs.

- the environmental rent derived from the volume of emission reduction certificates (CERs) and from the mechanisms by which their value is enhanced, and from which specific transaction costs associated with the CDM procedures must be deducted. Revenues can be generated from the sale of CERs, thus improving the attractiveness and competitiveness of investments in Developing Countries. This can also help the financial structuring of investment projects by attracting new financial partners keen to participate in the investment to obtain CERs granted to the projects by the CDM
- the social or « developmental » rent which is the increase in the supply of products and services necessary for the economic and social development of the country, or the production of positive externalities – versus reduction of negative externalities - for the host country.

Finally it is from the combination of these three rents, whose relative proportions differ between projects, and not only from the environmental rent, that the collective decision to implement a CDM project will arise. This decision will not only depend on the total value but also, possibly more importantly, on the negotiated sharing of these rents, case by case, between the various protagonists of the project.

2. The prospects of CDM projects in the electric sector

Many observers agree that the main potential for reducing emission in Developing Countries is in the electric sector. This is partly due to volume considerations, in view of the expected development of the supply, and partly due to questions of feasibility, as this sector offers many opportunities requiring only a small number of projects and industrial agents. It is important too that, as the electrical power sector meets the needs of a local market and not of an international one, the CDM projects in this sector do not involve relocating Northern activities to the South but increasing and improving the energy supply in the South⁵.

2.1. CDM in the conventional electricity sector (generation, transmission and interconnection, distribution)

The power generation technologies currently used in Developing Countries are generally very polluting (coal, oil). Thus large GHG emission reductions are possible when large international energy companies invest in non Annex B countries which open this sector to foreign investors. Emissions reduction is possible at several stages of the energy chain. On production level, substitution of primary energy sources and of technologies is the most obvious type of action (see Bosi, 2000).

At the transmission level, the emission reduction potential mainly lies in the possibilities for interconnection of different systems (regional integration in Southern Africa for instance) with large hydroelectric plants. On a smaller scale, the interconnection between small and low efficiency isolated systems based on diesel, with a national system supplied by modern thermal power plants, can also promote reduction of GHG emissions.

The management of distribution grids is also offers a large potential through loss reduction, thereby reducing the primary energy consumption and thus GHG emissions for a given demand.

⁵ In other sectors, certain relocation projects motivated mainly by cheap workforce, may try to take profit from high emission level baselines observed in the host country to get CERs from the CDM, although they only transfer emissions from the North to the South. Such "free-rider" projects must be avoided.

2.2 CDM and Demand Side Management (DSM)

Programs of energy conservation and demand-side management in industrial, tertiary and domestic sectors may equally lead to GHG emission reductions. Energy conservation projects often show a positive theoretical profitability. Does it mean that these projects will not be eligible by CDM although they are consistent with sustainable development objectives and are not spontaneously generated by the market forces? The existence of various barriers blocking the exploitation of energy conservation potentials has been well documented (see Jaffe & Stavins 1994 and Ostertag 2002). Several of these barriers appear in the list issued for public comment by the CDM Executive Board during the summer of 2002⁶, and Energy Conservation projects have been considered eligible by the COP 6.5 at Bonn⁷.

2.3. CDM and Rural Electrification⁸

In many Developing Countries, electric power sector reforms and privatisations have been accompanied by a reduction, even by near disappearance of the obligation to electrify rural areas. Furthermore, most of DCs are indebted and the local State cannot ensure universal access to the service. At the same time new techniques for decentralized rural electrification are developing, mainly supported by individual renewable energy based electricity generation systems (mainly individual photovoltaic systems, but also hydropower micro-plants, small windmills and hybrid systems associating already existing diesel groups and local production of New and Renewable Energy (NRE)). These small systems are flexible enough to adapt to small electricity volumes required by rural households. New institutional structures, such as « delegated management » have been created to make decentralized electrification programmes viable, associating private investments and public subsidies. Indeed, rural electrification is, in almost all countries of the world, a non profit-making activity, which requires official aid or cross-subsidies between consumer groups.

The contribution of NREs to GHG emission mitigation, makes the use of renewable energies in these countries eligible for the financing mechanisms arising from the international negotiations on climate i.e. the Global Environment Facility (GEF) and Clean Development Mechanism (CDM). Because the CDM has development objectives, rural electrification projects correspond perfectly to this mechanism. NRE projects smaller than 15 MW of installed power have already been proposed as being eligible in the category of "Type I Small Scale CDM projects" (Renewable Energy Projects) in the recommendations of the CDM Executive Board at the COP 8 in November 2002 in New Delhi⁹

3. An example: The Tahuamanu hydroelectric Project of Fund E7 in Bolivia.

The small towns of Cojiba, Porvenir and Villa Bush in the Pando Department in the north of Bolivia, near the Brazilian border, have an insufficient power supply that is both temporary and poor quality. Many users are currently supplied by isolated mini-grids energized by small diesel generators, some of which are very old. About two thirds of the cost of fuel used by those diesel groups is paid by the central State via a system of specific subsidized prices. Studies of the evolution of residential and industrial local demand forecast an increase of the rationing of the service in the coming years.

⁶ see Appendix A of the Annex B of "Recommendations for simplified modalities and procedures for small scale CDM project activities" (<http://unfccc.int/cdm/Panels/ssc/annexb.pdf>)

⁷ see paragraph 6 (c) of Decision 15/CP.7 :Principles, nature and scope of the mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol (<http://unfccc.int/cdm/rules/modproced.html>)

⁸ For a detailed discussion of this issue, see "Decentralised Rural Electrification in the Context of Negotiations on Climate Change" (chapter 4 of de Gouvello and Maigne, 2002).

⁹ Annex B of the Recommendations by the Executive Board to the Conference of the Parties on draft simplified modalities and procedures for small-scale CDM project activities (2002). (<http://unfccc.int/cdm/ebmeetings/eb005/eb5ressc.pdf>)

The installation of a new, more powerful and more efficient diesel group (2 x 640 KVA - 400V) on the main site (Cojiba) is being studied to improve the situation. A MV line linking Cojiba to Porvenir and Villa Busch is also being built. However, predicted demand forecast from the growth rates over the last 10 years, and the growth of industrial activities nearby¹⁰ indicate that rationing will be required again only four years after the installation of the new generators.

The alternative studied by the E7 Fund¹¹ and submitted to potential private partners consists of building an erasable dam (inflatable tube) equipped with three Kaplan turbines of 1,980 KW each, coupled to three alternators (3 x 2,200 KVA - 600V). An integrated company would be created (generation, transmission, distribution) to operate the system. The E7 Fund would own 51% of the shares¹². The other shareholders would be a Bolivian¹³ operator and possibly other financial partners if the operator did not wish to hold all remaining shares. The Environment Impact Assessment (EIA) that has been made in partnership with the local university and a local environmental NGO predicts a very limited impact on the local environment. This technical alternative could eliminate, on a long-term basis, the constraint that limits the electricity supply with the associated problems for all the small towns and local industries. It would also terminate consumption of fuel oil, which is both heavily subsidized and emits greenhouse gases. As such the project may be eligible for the Clean Development Mechanism.

The common decision of the E7 companies and the Bolivian authorities to plan this project under the CDM is the result of the production and the division of the triple rent that it will generate, i.e. :

- i) **The social or « developmental » rent** associated with the project which has several components:
 - the increase in (i) the benefits associated with the use of electricity due to improvement of the access to the service (lengthening of the service to 24 a day, the possibility of coverage for homes in the periphery of small towns), (ii) the quantity of electricity consumed and (iii) the quality of the service (end of rationing and power cuts due to failures). The benefits associated with the use of electricity include access to a good quality lighting, the use of basic domestic appliances (refrigerator, iron, etc.) and audio visual equipment, the improvement of collective services (health, education) and the development of productive use of electricity, which contributes to local economic and social development.
 - the reduction of the cost to the national collectivity, arising from the two thirds subsidy (the special fuel tariff) for isolated systems.

¹⁰ Particularly the industrial Brazil nut production and sawmills. The custom-free areas of Cojiba (Bolivian side) and Brazileia (Brazilian side which could be interconnected) are stimulating the economic development of the region. Infrastructure development projects to open up the area are in progress, especially the building of a 75 km motorway to Peru.

¹¹ E7 is an entity created by 7 large electricity companies of G7 countries to promote long-term development in the electricity sector, particularly in Developing Countries and in Economies in Transition (EITs).

The E7 has created, among others, the E7 Fund for sustainable energy development, which promotes projects aimed at the learning about mechanisms established under the Rio Convention and the Kyoto Protocol. The E7 FUND enjoys a special NGO status granted by the ECOSOC of the United Nations.

¹² The capital of the company to be created would be about 8 million US dollars, that is about one third of the necessary investment.

¹³ The potential operators are Electrogaz, whose main shareholder is Iberdrola, Cobee, the shareholders of which are American or Swedish and CRE a large Bolivian electricity cooperative

ii) The Commercial rent generated by the sales of electricity: this should provide an internal rate of return around 10.7% and would be shared between the E7's private partners and the Bolivian State:

- First, revenues from electricity sales at the statutory tariff, providing a return on the capital invested by the consortium for example as follows:
 - * 1/3 in the form of a contribution by E7, which is not seeking traditional private investor profitability, but nevertheless wants to recover its investment¹⁴
 - * 1/3 in the form of a 15 year bank loan at 6% with a grace period of 5 years¹⁵.
 - * 1/3 in the form of capital contribution by a private investor, remunerated at a rate of 18 % per year.
- Second, new fiscal revenues, resulting from taxing profits generated by the new activity.

iii) The environmental rent, which results from the lower CO₂ emissions than those in the reference scenario with diesel generators. Studies indicate that annual production will be 38GWh, corresponding to avoiding the emission of 30,400 tons of CO₂ a year.

In the case of the Tahuamanu project, the allocation of the environmental rent is one of the issues that have not yet been decided by the partners for two reasons. Firstly, because the practical modalities of the CDM have not been completely defined¹⁶. Secondly, the value of this rent can for the moment only be subject of speculation concerning future market prices of carbon, unless it is internalised to the project on the basis of a repurchase agreement between shareholders.

The progress of the Tahuamanu project allows elaboration of two pre-simulations to anticipate the future impact of CDM on the structuring of the clean energy generation project.

First, note that the reference scenario – the building of the initially planned diesel group – would lead to a production cost of USD174.00/MWh¹⁷ corresponding to USD 81.60/MWh after the subsidies granted by the Bolivian Government to fuels for electricity generation in isolated systems¹⁸.

Depending on the share of the production that will be sold, the financial outline above leads to a production cost of between USD 81.60/MWh to USD 69.0/MWh¹⁹, not taking into account the R&D costs. In order to avoid a large number of figures, we limit the analysis to the second case (USD 69.0/MWh).

We have examined two alternatives for the use of the carbon rent.

a) Recycling of the carbon rent in rebates on electricity prices

The first alternative for assignment of the carbon rent leaves the financing modality unchanged and recycles the carbon rent as rebates on electricity selling prices. In this case the local State and the users are both winners, because in addition to the « developmental » rent

¹⁴ For the purposes of the calculations below, we express this contribution in the form of following exploratory hypotheses; 1/3 loan by E7 at 0 % repayable in 25 years.

¹⁵ This type of preferential financing conditions can be obtained from a Development Bank.

¹⁶ The CDM Executive Board in June 2002 nominated a 10 member Expert Panel to develop recommendations on guidelines for methodologies for baselines and monitoring plans.

¹⁷ Calculated on the basis of an investment of USD910/KW and of an IRR equal to the standard discount rate of 10 %

¹⁸ The subsidized price is B \$ 1.05/l whereas real cost is B \$ 3.05/l, that is about a two thirds of subsidy.

¹⁹ In the second case, the totality of the production can be marketed, because the Cojiba-Brasileia connection is completed from the start. In the first case, we have adopted a more pessimistic scenario where the connection will be only complete in year 4.

described above, they also benefit from lower tariffs and eliminating subsidies on fuel. But the project is not reproducible for it depends on a financing at a rate of 0 % for one third of the initial investment cost.

The incidence of the carbon income on the price of electricity availability is explained in table n°1, assuming 25 USD a ton of CO₂²⁰. The full recycling of the carbon rent as tariff rebates makes it possible to lower electricity prices from USD 69.0/MWh to USD 49.0/MWh, that is by 29%.

Table n° 1 : recycling of the environmental rent as rebates on electricity selling prices.

Hypothetical international price of the avoided CO ₂ ton	Assessment of the total international rent	Rebate on electricity selling price
25 USD	0.76 Million of USD	- 20 USD/MWh

b) Recycling the Carbon Rent to attract a private investor

The second alternative recycles the carbon rent as an additional income every year, to ensure attaining sufficient remuneration for a more classical financial structure.

The function of this recycling is to give evidence that the environmental rent from the CDM would make reproducing such projects possible

As a result, the non profit-making financing by E7 is substituted by a classical capital contribution by a private investor, to be remunerated at an attractive level. It means that the share of financing ensured through classical private financing increases from 1/3 to 2/3. Table n° 2 present the IRR evolution according to the same carbon valuation. A price of USD 25,00/t CO₂ allows a remuneration that although not very high, remains acceptable for a conventional private investor in the electricity generating sector.

The Bolivian State still benefits, as previously, from a CDM rent by the elimination of fuel subsidies, allowing funding of other programmes. If carbon prices on the international market are lower, an attractive level of capital remuneration could be ensured by (i) increasing the financing share under favourable conditions by development banks, or (ii) obtaining financial participation from Bolivian Authorities, for instance by recycling a part of the saved subsidy.

Table n °2 : Viabilisation of private investment by CDM carbon rent.

International price of avoided CO ₂ per ton	Return on Equity
25 USD	15.0 %
0 USD	10.6 %

²⁰ This estimated price, which corresponds to a plausible value at the moment when the exercise was performed using Business Plan simulation tools (that is before the withdrawal of the US from the Kyoto Protocol), may appear as high today, mainly because of the uncertainty regarding the management of hot air of the Economies In Transition (EITs), including Russia. However, the position as the dominating monopoly of the EITs may lead them to try to maximize their carbon rent. Now the marginal emissions reduction costs observed in other Annex B countries are high. Thus it is plausible that market prices will increase. In a recent pre-simulation exercise, the broker Natsource uses a price of 23 USD/tCO₂ in 2010 (Natsource, July 2002). Hourcade and Gherzi indicate a price range varying from 15 to 100 USD/tC from pre-simulations with 12 different price models (Hourcade and Gherzi, 2002)

4. Conclusion

In conclusion, the objective of this paper was to present the context in which conventional investors in the electricity sector could be placed when making decisions regarding future opportunities of eligible projects for the Clean Development Mechanism.

Although certain modalities of the CDM remain to be detailed by the CDM Executive Board, it is already possible to investigate projects, both in terms of contributions to development and to reductions of greenhouse gas emissions. Such investigations can initiate a learning process regarding the future influence of the CDM on investment decisions and on its capacity to promote the use of cleaner technologies in Developing Countries.

The Tahumanu project initiated by E7 is a response to this need to learn. It allows exploration of the formulae for sharing the additional carbon rent coming from CDM between the host country and the private investor, and the viability of such investments for conventional investors in the electricity sector.

Non Annex B host countries have insisted on the benefits that such projects should bring in terms of development. But it is also clear that governments in DCs will have to make choices between maximizing the direct carbon income by retaining a high share of CERs, and maximizing the capacity to attract additional foreign investments, by leaving the carbon rent to private project developers.

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